# Journal of the Society of Arts.

*FRIDAY, SEPTEMBER* 18, 1868.

## Announcements by the Council.

### EXAMINATIONS, 1869.

The Programme of Examinations for 1869 is now published, and may be had *gratis* on application to the Secretary of the Society of Arts.

### PRIZES.

The Council, at the suggestion of the Food Committee, offer the following prizes for Improved Railway Meat Vans, Milk Vans, and Milk Cans :—

1. For an improved method of conveying meat by rail, the Society's *Silver Medal* and £10.

The object in view is to reduce to a minimum the deterioration which meat now suffers in its transit by rail. The principal evils to be avoided are—excessive changes of temperature, and injuries by pressure, by handling, exposure to dust, insects, &c. This prize may be awarded for an improved railway meat van or for a travelling meat larder suitable for railways.

Model on a scale of half an inch to a foot to be sent in.

2. For an improved method of conveying milk cans by by rail, the Society's *Silver Medal* and £10.

The object in view is to reduce to a minimum the deterioration which milk now suffers in its transit by rail in the ordinary open trucks. The principal evils to be avoided are—the heating and shaking of the milk cans.

Model of an improved railway milk van, on a scale of half an inch to the foot, to be sent in.

3. For an improved railway milk can, the Society's *Silver Medal* and £10.

The object in view is to reduce to a minimum the deterioration which milk now suffers in its transit by rail in the ordinary milk cans, or " churns." The principal evils to be avoided are—the heating of the milk, and all motion within the can which may cause the buttery particles to separate.

A specimen of the improved railway milk-can to be sent in.

The models and specimens for competition must be forwarded to the Secretary of the Society of Arts before the 1st February, 1869.

### HARVESTING CORN IN WET WEATHER.

The Essay by Mr. W. A. Gibbs, of Gillwell-park, Sewardstone, Essex, for which the Gold Medal of the Society and a prize of Fifty Guineas were awarded, is now ready. Published by Messrs. Bell and Daldy, York-street, Covent-garden, publishers to the Society of Arts; price one shilling, illustrated by woodcuts.

### SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed " Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

## Proceedings of the Society.

### CANTOR LECTURES.

"ON FOOD." By DR. LETHEBY, M.A., M.B., &c.

LECTURE IV., DELIVERED MONDAY, FEBRUARY 10TH.

*Preservation of Food—Unwholesome and Adulterated Food.*

It requires no argument to show that the preservation of food is a matter of great public importance; for it not only enables us to provide against actual want in periods of unusual scarcity, but it also affords the means of equalising the distribution of food at all times, so that the excess of one country may be used in supplying the deficiency of another. In the pastoral districts, for example, of Canada, Australia, Tasmania, the Cape of Good Hope, Mexico, the Argentine Republic, and the Brazils, thousands of tons of meat are always available as food, and yet they are lost to us because of the difficulties of preserving it. In South America, at least two millions of beasts are annually slaughtered for the fat, skin, and bones, the flesh of which could be supplied here at less than 2½d. per pound. So also in Australia, the amount of meat available as food is practically inexhaustible. Last year Mr. Philpott stated to the Food Committee of the Society of Arts, that he himself was in the habit of melting down from 1,000 to 1,500 sheep daily for four months together; and that in the vast districts of rich pasture-land from Victoria to Brisbane, there was an unlimited supply of the very finest meat—all of which was at present entirely wasted, because of the difficulty of disposing of the flesh; and, therefore, the carcasses of the animals were melted down for fat. A bullock in Australia, he said, costs only from £3 to £4; and legs of mutton of the very best quality were, when salted, sold for three shillings a-dozen. If some simple and practicable means could be devised for preserving such meat, it might be supplied to our markets at less than 3d. a pound.

Until recently the only process employed for this purpose was the rude method of salting the meat, but the deterioration of it was so obvious, and the distaste for it so general, that it was only practised to a limited extent, and for occasions when fresh meat could not be obtained. The salt junk of the navy in olden time was a good example of the wretchedly unwholesome and indigestible meat prepared, for it could hardly be called preserved, by this process. Recognizing, therefore, the necessity for a bettter means of preserving food, the naval authorities of every country appealed to science, and gave the largest encouragement to inventors. A further stimulus to invention was created by the necessity for supplying our Arctic explorers with good and wholesome food during their long winter residence in the frozen seas of the north; and as that inquiry was set on foot, not merely for the purpose of discovering a north-west passage to our possessions in America, but also with the view of prosecuting scientific research in almost inaccessible regions, an unusual inducement was offered for the preparation of such food. The demand thus created was soon acknowledged by science, and was also met by the practical skill of the manufacturer, so that the Arctic voyager went confidently on his journey, knowing that he had other food than the unwholesome junk of the navy. The earliest preparations supplied to him were mixtures of dried meat with sugar and spice (*pemmican*), but after a time they were furnished with fresh meat, preserved in air-tight cases. At first the supply was chiefly for voyagers in cold countries, but when the value of this method of preservation became known, the European residents of hot climates, as India, eagerly sought for the fresh foods which they were accustomed to use in their own country, and thus an additional stimulus was given to this process of manufacture. At the present time it has acquired gigantic proportions.

I have before me a list of the specifications of patents relating to the preservation of food, from the year 1691 to the end of 1855, and I find that only one was described in the seventeenth century, and three in the eighteenth, while as many as 117 were specified in the first 55 years of the present century. Invention, however, has not been prolific of new processes, for it is mainly confined to an application of one or two simple elementary principles—26 of the patents, for example, are for the preservation of food by drying; 31 by excluding atmospheric air; 8 by covering the food with an impervious substance, as fat, extract of meat, gelatine, collodion, &c., and 7 by injecting meat with various salts.

But before we proceed with the examination of these processes, it will be advantageous to inquire a little into the circumstances which favour organic decomposition. It would seem, from experiment and observation, that three concurrent conditions are absolutely necessary for active putrefaction—namely, the presence of much moisture, the access of atmospheric air, and a certain temperature, as from about 40° to 200° of Fahrenheit; any of these being absent, the organic substance resists decay. All preservative processes must, therefore, depend on an application of one or other of these principles; and perhaps we may add a fourth—namely, the action of chemical agents. Let us review them in detail.

1st. *The preservation of substances by drying them* is of very ancient date. In our anatomical museums we have long known that specimens of the animal body may be preserved for an indefinite time by drying them, and then varnishing them so as to exclude moisture. Here is a dissection prepared in that manner, which has been used for lecture illustration at the London Hospital for more than half a century, and yet it is as sound as when it was made. In warm climates it has been a practice for ages to preserve fish, and even meat, by drying them —the meat being cut into strips and exposed to the action of warm dry air. Charqui or South American beef, which you see here, is an example of it. It is obtained from animals that are grass-fed, and they are killed by pithing and then bleeding them. Directly the hide is taken off, the flesh is stripped from the bones and allowed to cool. It is then placed on a table, and jerked, or cut up into thin slices, which are piled up in heaps with alternate layers of salt. After standing twelve hours the meat is turned, and fresh salt is added where necessary. The next day the salted strips are placed upon hurdles, and exposed to the sun to dry. It requires two or three days to dry the meat thoroughly, and, for fear of damp, it is always taken in-doors at night. There are several varieties of this meat, as *pato*, which is the best and most free from sinew; *manta*, the second quality; and *tasajo*, the third, which is very thin and full of sinews. All the varieties require to be well soaked in water, and then to be cut small and cooked by prolonged boiling. But animal foods are not well preserved in this manner, as they lose their flavour, and become tough and indigestible; the fat also gets rancid, and in damp weather the meat absorbs moisture and becomes mouldy and sour. Perhaps the lean parts of meat, as the heart, tongue, and strips of muscle might be advantageously preserved in this way, especially in warm and dry climates. The Food Committee of this Society reported favourably of a specimen of dry powdered beef from Queenstown, which they said was in excellent condition, and contained about four times as much nutritious matter as ordinary meat. Generally, however, the fat is very rancid, even when pains are taken to prevent the substance from getting mouldy. It is for the same reason that all attempts to preserve milk and the yoke of eggs by drying have failed, although the dried white of egg will keep well, as in the process of Mr. Charles Lamont, where the albumen is dried in thin scales—forty-four eggs making about one pound of the preparation. Absorbent substances mixed with the fatty food will obviate the difficulty, to some extent, as in the preparation of *pemmican*, where sugar and spice are added to the dry powdered meat; and in the several processes for preserving milk by evaporating it and mixing it with sugar, &c., as in the patents of Newton, (1835), Grimwade (1847 and 1855), Louis (1848), &c.; as well as the process of Davison and Symington (1847) for preserving eggs by mixing the yokes and whites with flour, ground rice, or other farinaceous substance, and drying. Extract of meat also may be preserved in the same manner, as in the patent of Donaldson (1793), of Robertson (1851), and of Borden (1851), where the extract, after the separation of fat, is mixed with farinaceous matters; in the last case it is also baked in the form of biscuits. In the year 1854, MM. Blumenthal and Chollet obtained their patent for combining meat and vegetables in the form of tablets, by first drying the meat and vegetables and pressing into cakes, and then submitting them to successive immersions in rich soup—allowing them to dry in warm air after each immersion. When the extract of meat is made without fat or gelatine, as in the case of Liebig's extract, it may be kept for a long time in a pasty condition, without mixing it with farinaceous matters, although the preparation of it with baked flour, as already described, is a great improvement.

The process of drying is, however, best adapted for the preservation of vegetable substances, and it has been so used from time immemorial, as in the keeping of pot-herbs, in preparing the tea-leaf, in making hay, &c. In this country, the first recorded patent for preserving vegetables by drying them, was granted in 1780, to John Graefer, who sought to retain the flavours of vegetables by first dipping them in boiling salt and water, and then drying. Forty years later (1820) John Vallance obtained a patent for preserving hops by drying them, and then compressing them into a small space. Then came the patents of Edwards (August, 1840), for boiling, granulating, and drying potatoes; and of Grillett (November, 1840), for preserving both cooked and uncooked potatoes by drying. Ten years afterwards (in November, 1850) Masson obtained his patent for preserving vegetables by drying them and forcibly compressing them, so that they were reduced to one-seventh their original bulk—a cubic yard containing rations for 16,000 men. This process has been very successful, and it is still practised by Devaux, Chollet, and others, for it serves for the preservation of all kinds of vegetables, as potatoes, cabbages, carrots, cauliflowers, beans, apples, &c.; and when steeped in water they reabsorb their natural proportions of moisture and swell out to their original size. They are, however, somewhat deficient of flavour, and they require prolonged boiling, as from one and a-half to one and three-quarter hours, to cook them.

By a more careful process of drying, Mr. Makepiece has managed to preserve both the colour and the flavour of vegetables, especially of pot-herbs, as you may see from these specimens.

Altogether there are, or have been, about thirty-one patents in this country for the preservation of various articles of food by drying them.

2nd. *The preservation of organic matter by excluding atmospheric air* is, like the last, a very ancient process. The old practice of burying the dead in leaden coffins, and the still more ancient custom of swathing them in resinous bandages or waxed cloths (called cerements), owe their preservative powers to the exclusion of atmospheric air; and it is remarkable, seeing the efficacy of the process, that the scientific principle of it was not long ago recognised and applied to the preservation of food. The first patent of the kind that I am acquainted with in this country, was granted to Francis Plowden, in June, 1807; and he describes it as a process for "preserving butchers' meat, animal and other comestible substances, by encrusting them with a substance, which must not only resist the effects of atmospheric air, but must not communicate any noxious quality to its con-

tents," and for this purpose he employed essence or extract of meat—the substance being dressed, so that it may preserve the longer, is wiped dry, and put into a wooden vessel, and the hot extract is poured over it in a fusible state, so as to find its way into every vacuum. Three years later (in February, 1810), Augustus de Heine took out the first patent for preserving meat, by exhausting the air from the vessel containing the meat, and he contrived a machine for the purpose, as the action of the common air-pump was tedious. Six-and-thirty years after this (1846) the late Mr. Warington, of Apothecaries' Hall, obtained his patent for the preservation of animal substances, by coating them with common glue, gelatine, or concentrated meat gravies, or otherwise by dipping them in warm solutions of such substances; or by wrapping them in waterproof cloth, or covering them with caoutchouc, gutta-percha, or varnish. These mark the starting-points of the various processes now in use; for example:—

(*a*). Of those which owe their operation to the exclusion of air, *by filling up the vessel with something hot*, there are the patents of Plowden (1807), who used rich gravy or extract of meat; of Granholm (1817), who used hot fat, or hot animal jelly; and of Wothly (1855), who used oil, as in preserving anchovies. I am rather surprised, considering how easily the exclusion of air is effected by surrounding the substance with hot fat, that this method of preserving meat has not been adopted in Australia and South America; for as the fat which they prepare from their wild stock is sent to this country in casks, there would be no difficulty in sending with it the finer descriptions of joints, as legs of mutton and good pieces of beef. The process should be conducted as follows:—When the fat is melted, and is at a temperature of from 240° to 250° Fahr., the fresh joints should be plunged into it, and kept there for a few minutes, so that the superficial moisture might be thoroughly evaporated. They should then be immediately packed in sound dry casks, and filled up with hot fat, at a temperature of 212° or thereabout. In this manner the fat and the joints might be transmitted to this country, and on their arrival there would be no difficulty in melting the fat while in the casks, and then removing the preserved joints.

Vegetable substances are frequently preserved in bottles filled up with hot syrup, and the practice is a very old one. Hot water is also used for the same purpose, and this method dates from the year 1807, when this Society gave a premium to Mr. Saddington for his method of preserving fruits without sugar. His process was to gather the fruit a little before ripening, and to put it immediately into clean bottles,—filling the bottles with the fruit to the neck. They were then placed in a vessel of cold water, and heat was applied until it rose to the temperature of 160° to 170° Fahr. After standing exposed to this temperature for half-an-hour, the bottles were filled up to within an inch of the top with boiling water, and were then immediately corked and covered at the top with cement. The action of the heat was not merely to expel atmospheric air from the bottles, but also to coagulate the vegetable albumen of the fruit. Fruits and green vegetables are still preserved in this manner, a little alum being generally added to the water in the bottle, for the purpose of hardening the tender skin of the fruit, and so preventing its disfigurement by bursting.

(*b*). A process not very unlike the preceding, is that which consists in *the destruction of the oxygen of the air in the vessel, by heating the substance in it*. This is the plan of M. Appert, who, in 1810 (three years after the publication of Mr. Saddington's method), obtained the reward of 12,000 francs, offered in the preceding year by the French Government, for the best method of preserving food. Here is the book which M. Appert wrote at the time, and he tells us to cook the food to some extent, and put it into strong glass bottles—filling them almost to the top. The bottles are then to be securely corked, and exposed for some time to the action of boiling water. To guard against accident from bursting, the corks are to be wired down, and the bottles wrapped up separately in cloths. After this the corks are to be well covered with pitch, to exclude atmospheric air. A like process was patented in the autumn of the same year (1810), by Mr. Peter Durand, who, no doubt, derived it from the published account of M. Appert, dated nine months before; and since then, many such patents have been obtained, which I need not describe. Attempts have frequently been made to preserve milk by this process. Appert recommended that the milk should be boiled down to about half its bulk before putting it into the bottles; and in 1847 Bekaert tried to improve the process by adding carbonate of soda to the milk. Later still, in the same year, Martin de Lignac obtained a patent for preserving milk, by evaporating it to one-sixth of its bulk before bottling it. Then there were the patents of Symington and of Moreau (1853), but all these methods have failed in practice, on account of the difficulty of preventing the separation of the butter.

(*c*). The preservation of food *by exhausting the air from the vessel containing it* dates, as I have said, from the year 1810, when Augustus de Heine proposed to use a vessel with a valve in the top of it, which allowed the air to be drawn out by means of a special apparatus, but not again to enter. The exhaustion, however, was so imperfect that the process did not answer. In 1828 Mr. Donald Currie improved it by admitting carbonic acid gas into the vessel after it was thoroughly exhausted; and later still, in 1836, M. Leignette still further improved it, by filling the vessels containing the food with salt and water, and then letting out the liquid through the aperture, which remained open for that purpose, while carbonic acid gas went in. Six years after this (in 1842), Mr. John Bevan patented a process for drawing out the air by an exhausting apparatus, and then admitting a warm solution of gelatine; and in 1846 Mr. Rettie employed, in the like manner, a solution of common salt. But none of these methods were successful; nor was the patent of Mr. Ryan, in 1846, for using gases, chiefly acetic acid vapour, and carbonic acid gas. The most perfect process of this kind was patented by Messrs. Jones and Trevethick. It consists of an apparatus whereby the exhaustion of the vessel containing the raw food is effected in an air-tight trough of water, and thus the entrance of air and the collapse of the sides of the vessel are completely prevented. After the exhaustion pure nitrogen is admitted into the vessel, for the purpose of diluting the residuum of air, and it is again exhausted. Lastly, a charge of nitrogen, containing a little sulphurous acid, is let into it, and thus the last trace of oxygen is chemically absorbed. The vessels are now in a proper condition for removal from the air-tight water trough, and for having the apertures sealed with solder. Meat, fish, and poultry preserved in this manner has been found good after seven or eight years; and specimens of them were exhibited in the London exhibition of 1862.

(*d*). The most common method of driving out the air *is by means of steam*. The food is put, with a charge of water, into a tin case with a hole in the top, and when the water is boiling actively, and steam has displaced the air, and is escaping freely, the hole is stopped with solder. This process dates as far back as 1820; but the first patent for it was granted to M. Pierre Antonie Angilbert, in 1823. He had, however, a very rude method of applying heat to the tin vessels, and this was improved by Wertheimer in 1840. In the month of January of the year following Mr. Gunter improved it still further; and later in the same year both Goldner and Wertheimer obtained patents for using a bath of muriate of lime for heating the vessels. This, in fact, is the practice at the present time by Goldner, McCall, Richie, Morton, and others, who are largely engaged in the preservation of food. The details of the process for

effecting it are as follows:—The raw meat and vegetables are put into the canisters and soldered down—a pin-hole aperture being left in the lid. The canister is then subjected to the heat of the bath (a little above 212°) until the contents are about two-thirds cooked; and then, while the steam is blowing freely out, the aperture is dexterously sealed tight with solder. The canister is then painted over with a stiff oil paint, and is exposed for some time in the testing-room to a temperature sufficiently high to promote decomposition. If the canister shows no sign of bulging out from the generation of putrefactive gases, it is considered sound. Messrs. Hogarth and Co., of Aberdeen, use steam instead of the muriate of lime bath.

Meat preserved in this manner will keep for a considerable time. At the exhibition of 1851 vouchers were given for some of the samples that had been preserved for twenty-five years; and at the exhibition of 1862 I examined specimens of food that had been kept for more than thirty years. To-night, through the kindness of Messrs. Crosse and Blackwell, I am able to show you a specimen of preserved mutton, which has been in the case forty-four years, and you will perceive that it is in excellent condition. It formed part of the stores supplied by Messrs. Donkin and Gamble in 1824 to his Majesty's exploring ship *Fury*, which was wrecked in Prince Regent's Inlet in 1825, when the cases were landed with the other stores, and left upon the beach. Eight years afterwards (in August, 1833), they were found by Sir John Ross in the same condition as they were left; and he wrote to Mr. Gamble at the end of that year, saying, "That the provisions were still in a perfect state of preservation, although annually exposed to a temperature of 92° below and 80° above zero." Some of the cases were left untouched by Sir John Ross; and after a further interval of sixteen years, the place was visited by a party from H.M.S. *Investigator*, when, according to a letter from the captain, Sir James Ross, "the provisions were still in excellent condition, after having lain upon the beach, exposed to the action of the sun and all kinds of weather, for a period of nearly a quarter of a century." Messrs. Crosse and Blackwell have placed the original letters in my hands for perusal, and they show, beyond all doubt, that meat preserved in this manner will keep good for nearly half a century —in fact, the case of boiled mutton now before you has been preserved for forty-four years. There can be no question, therefore, as to the success of the process; and hence it is largely practised, not only in this country, but also in our colonies, where food is abundant. In this way preserved salmon and lobsters are sent to us from Newfoundland, turtle from Jamaica, beef and mutton from Canada, and the dainty tail of the kangaroo from Australia. There are, however, two serious objections to the process—namely, that the meat is nearly always overcooked, and the cases are likely to buckle and crack from the constant pressure of the atmosphere —there being a vacuum within them. The over-cooking arises from a desire to ensure the complete exclusion of atmospheric air by the steam. Mr. Nasmyth has proposed, in his patent of 1855, that a little alcohol should be mixed with the water, so that the boiling-point may be reduced; while Mr. McCall, taking advantage of the absorbent action of sulphite of soda on oxygen, recommends a less prolonged boiling and the use of a little of that salt. The salt is contained in a small capsule, fixed by means of soft solder to the inner surface of the cover of the case. When the food is about two-thirds cooked, and steam is freely escaping, the hole in the lid is stopped with a very hot iron, which melts the soft solder of the capsule within, and so sets free the little pellet of sulphite of soda, which speedily absorbs the remnant of oxygen left in the case.

The other difficulty, namely, the cracking of the case from atmospheric pressure, is obviated, as I have already explained, by the introduction of inert gases, as carbonic acid, nitrogen, &c., and with a little sulphurous acid, and these have been the subject of many patents, as of Currie (1828), Leignette (1836), Ryan (1846), Nasmyth (1855), and others.

(*e*). The last method of any importance for excluding atmospheric air from food, is *by coating it with some impervious material.* This plan, as I have already stated, was first suggested by the late Mr. Robert Warington, who, in March, 1846, obtained a patent for the use of "common glue, gelatine, or concentrated meat-gravies; or thin cream of plaster-of-Paris, which, when set hard, was to be saturated with melted suet, wax, stearine, &c." "The things were then to be wrapped in water-proof cloth, or covered with caoutchouc, or gutta-percha; or coated with a varnish of these substances; or kept submerged in glycerine, treacle, elaines, oils, or other such matter not liable to oxydation." Nine years after this, in January, 1855, a patent was obtained by Messrs. Delabarre and Bonnet, for preserving meat, bread, eggs, vegetables or pastry, by coating them with a varnish, made from the flesh and bones of animals, by boiling them, and obtaining a rich syrup. This, when clarified, was used to cover the parboiled meat or vegetables. In the month of February in the same year, a like patent was granted to Mr. Hartnall, for a process of preserving animal and vegetable substances by immersing them in baths, consisting of gelatine and treacle dissolved together in certain proportions; then drying, redipping, and covering with charcoal powder. Later still, in the same year, Mr. Brooman patented the use of albumen and molasses, as a coating for meat, after the meat had been partially dried, and then suspended in an air-tight vessel, charged with sulphurous acid. Lastly, in the month of December of the same year, Messrs. Bouëtt and Douein obtained provisional protection for the use of collodion, either alone or mixed with other suitable substance.

But the best example of this method of preserving meat is the process of Dr. Redwood, whereby the meat is first covered with paraffin, and then with a flexible coating of gelatine, mixed with glycerin or treacle. The joints are dipped into a bath of paraffin, having a temperature of from 240° to 250° of Fahrenheit, and are kept therein until the surface moisture is evaporated. They are then transferred to a colder bath of paraffin, from which they receive two or three coatings, prior to their being covered with the last flexible covering of gelatine, &c. When the meat is required for use, the paraffin is easily removed from it, by plunging it into boiling water, which dissolves the flexible coating and melts the paraffin. The paraffin floats upon the water, and, when cold, may be collected for future use.

The common methods of preserving foods by forcing them into skins, as in the case of German sausages, lard, &c., is of very ancient date; although a patent was granted to Mr. Palmer, in 1846, for the preservation of the fat of beef, mutton, veal, or lamb, when fresh, by melting them, straining, and then packing in bladders.

3rd. *The preservation of food by cold* is a well-known process, for every one is acquainted with the fact that meat will keep for a long time in the winter-season without deterioration; but the extent to which this preservative power may be carried is not well known. Animals, we are told, have been found in a perfect state of preservation in the frozen earth of the arctic regions, where they must have been buried for centuries. Last year, indeed, a communication was made to the Royal Society, by Dr. Carl von Bear, of the fact that the entire body of a mammoth was found in the frozen soil of arctic Siberia. How long it had been so preserved it is hard to conjecture, but it must have been there for ages. Another good example of the preservative power of cold was observed in Switzerland in the autumn of 1861, when the mangled bodies of three Chamounix guides were found at the lower part of the Glacier de Boissons. The flesh of the bodies was perfectly preserved, notwithstanding that 41 years had elapsed since the unfortunate men lost

their lives. They were carried away by an avalanche from the grand plateau of Mont Blanc, in the month of August, 1820, while attempting to ascend the mountain with Dr. Hamell; and no trace of them was discovered until the corresponding month of 1861, when, by the slow descent of the mountain ice, their remains were brought to the lower glacier. So well is this preservative power of cold known to the inhabitants of Russia, Canada, and other northern climates, that it is a common practice to slaughter fat animals on the approach of winter, when fodder is getting scarce, and to preserve their carcases by burying them in the ice or frozen earth; and they are thus preserved from the middle of November to the early part of May. We also have a practice of packing salmon in ice; and we receive game and poultry from America, and send the like to India in boxes surrounded with ice. The application of this method of preserving food is almost without limit, for not only can we obtain a stock of ice for such a purpose in the winter season, but it may be brought to us at any time from colder regions of northern Europe, or it may even be manufactured at a cost of less than half-a-guinea a ton. There is a machine of Mr. James Harrison, of Australia, made in this country, which is said to be capable of producing 8,000lbs. of ice a day, at a cost, including all expenses, and with a good margin for profit, of ten shillings a ton. Why, therefore may we not use ice in the summer months for the preservation of food? Dealers could easily provide themselves with close rooms containing ice, in which the food might be placed; and we ourselves might use ice-boxes more commonly in our households. It might interest you to know that the first patent for the preservation of food in this manner was granted to John Lings, in 1845.

Again, a temperature of from 200° to 212° will also arrest putrefaction; and joints of meat may be preserved for a time by dipping them every now and then in boiling water.

The 4th and last method of preserving food is *by the use of chemical agents, called antiseptics*, which act by destroying infusorial and fungoid life, and by forming compounds which are not prone to decay. Foremost of these is *common salt*, which has been used from the earliest time; but it is not a good agent for the preservation of meat, as it renders it tough, gives it a bad flavour, extracts the soluble constituents of it, and makes it hard and indigestible. The process, however, is much better managed at the present time than formerly, when the hard junk of the navy was the common diet of our sailors; and, considering how easily it is applied, it is not surprising that it is almost universally practised. In some parts of England and Wales it is the custom of the better classes of agricultural labourers to fatten a pig during the summer, and kill it and salt it for the winter. Hams and tongues are treated in like manner; and so are fish when they are plentiful among the inhabitants of our coasts. As far back as 1800 a patent was granted to Mr. Benjamin Batley for curing and preserving herrings and sprats by salting them; and it would seem that his process was very successful, for in the following year he obtained a patent for the like treatment of other fish. The dainty *caviare* of the Russian is nothing but the salted roe of the sturgeon. Even vegetables may be preserved in salt and water, as in the case of olives.

Other saline substances, saltpetre, acetate of ammonia, sulphite of potash, or soda, muriate of ammonia, &c., are also good preservative agents, and are the subjects of several patents. Here is a specimen of meat preserved by wetting it with the solution of one part of acetate of ammonia and nine of water; and here another, which has been similarly treated with a weak solution of sulphite of soda. It is only necessary to brush the solution over the surface of the fresh meat, and when dry it will leave the meat in such a state as to resist decay. Instead of covering the meat with the solution, it may be injected with it, as in the patents of Long (1834), Horsley (1847), Murdoch (1851), and others.

After meat or fish is salted, it is frequently dried and smoked by exposing it in close chambers to the vapours of smouldering peat, wood, straw, &c., and in this manner it becomes impregnated with the dark-brown empyreumatic oil of the burning wood. The chief agent concerned in the preservation of food thus treated is the creosote of the empyreumatic oil, and this it is which gives the food a smoky flavour. A like effect may be produced by dissolving the creosote of wood-tar in vinegar, and brushing it over the salted joint. The creosote of coal-tar (*carbolic acid*) is also a powerful antiseptic, but its flavour is not agreeable, and therefore it is not used in the preservation of food; although it is extensively employed, in the form of coal-tar, dead-oil, or creosote, in the preservation of wood, canvas, &c.; and the perfection of purity to which it is now brought by Dr. Crace Calvert and other manufacturers, encourage its use in medicine and surgery.

*Spirit of wine* and *vinegar* are other preservative agents which owe their antiseptic power to their destructive action on infusorial life, and to their combining with the albuminous constituents of food. Cherry brandy and pickles are good examples of this.

Lastly, I may state that the fumes of burning sulphur (*sulphurous acid*) are very powerfully antiseptic; and many patents have been taken out for their employment in the preservation of food. In the spring of 1854, Laury obtained a patent for it, the gas being introduced into the vessel containing the substance to be preserved. Later in the same year, Bellford received provisional protection for the use of sulphurous acid with about one-hundredth of its volume of hydrochloric acid—the object being to prevent the sulphurous acid combining with the alkaline salts of the meat, and so giving it an unpleasant taste. The acids were to be used in solution, and the meat immersed in it for twenty-four hours. In the following year (1855) there were three patents—those of Brooman, Demait, and Hands, for the use of the acid in a gaseous form; and in the specification of Demait it was directed that the substance should be preserved by hanging it up in a chamber, and exposing it for a time to the action of the gas. Professor Gamgee has revived this process in a recent patent, and with certain modifications. He recommends, for example, that the animal should be made to inhale carbonic oxide gas, and when it is nearly insensible, it should be bled in the usual way. After the carcase is dressed, it is to be suspended in an air-tight chamber, which is to be exhausted of air, and then filled with carbonic oxide gas, to which a little sulphurous acid has been added. It is to remain exposed to these gases for twenty-four or even forty-eight hours, and is then to be hung up in dry air; after which it is said that the carcass will keep for many months, without perceptible change in taste or appearance. The process has been tested by killing meat in London, and sending it to New York; and after the lapse of from four to five months, the meat has been pronounced good by a practical butcher. I am very much inclined to think that the real preservative agent is the sulphurous acid, and that the highly-poisonous carbonic oxide gas might be advantageously excluded from the chamber.

And now, in leaving this part of the subject, I cannot refrain from saying that the history of these patents for the preservation of food affords very striking instances of the necessity for an amendment of our patent laws; for not only is there a frequent disregard of all scientific principles in the construction of the patents, but in many cases there is also a total disregard, or else profound ignorance, of what has already been done in the matter. Repetitions, therefore, occur again and again of the same process, nearly always imperfectly specified; and, on the other hand, the most ridiculous propositions often assume an importance as if for no other object than that of obstructing invention. Out of the 121 patents for

the preservation of food, which I have had an opportunity of examining, there are hardly a dozen that can be regarded as either useful to the community or profitable to the patentee.

(*To be continued.*)

# Proceedings of Institutions.

## UNION OF LANCASHIRE AND CHESHIRE INSTITUTES.

A conference of members of the Council of the Union of Lancashire and Cheshire Institutes and Science Teachers was held on Wednesday evening, the 9th Sept., at the Mechanics' Institute. Dr. Pankhurst, the hon. secretary of the Council, presided, and there was a numerous attendance.

The Chairman, in opening the proceedings, said the first duty which he had to discharge was to welcome, on the part of the Council, the teachers at that conference. He was sure that they would all regret the absence of the chairman of the Council, Mr. Alderman Rumney. Nothing but the necessities of the distance would have prevented him from being with them upon that occasion. The business of the evening was to hear a paper from Mr. Thomas Brown, upon the following subject:—"The Government Scheme of Technical Instruction and Examination, and the Future Prospects of Science Schools and Science Teachers." It must be gratifying to know that the pre-eminence of Lancashire and Cheshire, in the diffusion amongst the artisan class of science and instruction, had been more than maintained during the past year. Last year there were under instruction in connection with the Union, 1,930, while this year there were 2,769. In the past year 1,019 passed the examination, while in this year 1,493 had passed. Last year there were 59 classes in operation; this year 19 new schools had already been formed, and 13 were in course of formation, principally, he ought to say, through the zealous activity and enthusiastic zeal of their visiting agent, Mr. Lawton. In the presence of the amount of business they had to get through, it was undesirable to offer from the chair any observations. He ought, however, to direct attention to three points. They ought to have a sound theory about the relation of science to the productive arts; they ought to have a scheme of instruction adequate to realise, as far as might reasonably be expected, the theory which they had conceived; and, finally, they ought to be in possession of that amount of teaching power which should be able to give to the machinery the greatest amount of efficiency.

Mr. Thomas Brown (Chorley) then read the following paper:—Mr. Chairman and Gentlemen,—I fear that, having had so short an experience in science teaching, it may appear presumptuous on my part to attempt to read a paper before you on the subject. This fear nearly induced me to decline to do so, but I remembered that but for the Council of this Union of Institutes and their agent, I should not have become a science teacher at all, nor as yet would there have been a science school formed in the little town in which I reside. I therefore felt it my duty not to allow any little delicacy to stand in the way of making a humble attempt to aid them in their efforts to attain the grand object they have in view. In these they have hitherto been so far successful as to receive well-merited compliments from the officers of the Government Science Department. Moreover, I have been an elementary teacher under government inspection about 20 years, and have during the last two years passed examinations in 21 different subjects in science and art, under the Society of Arts and the Science and Art Department. This is a guarantee that I have necessarily pretty extensively studied the various schemes and codes in existence for the education of the working classes, and will, I trust, render further apologetical remarks unnecessary. I shall be compelled to treat the subject dogmatically rather than argumentatively. I will state my opinions boldly and fearlessly, hoping that, whether you agree with me or not, they will bring out the opinions and the results of the experience of the gentlemen present in the after discussion. The object of the government scheme of Technical Education is to make provision for the instruction of the more intelligent and enterprising members of our artisan classes in the scientific principles to be applied in their various trades, so as to make them more intelligent workmen, and to fit the best of them to fill efficiently the posts of foremen and managers in our workshops. The majority of them are thus expected to repay the expense of their instruction, by helping forward an increased prosperity in trades, manufactures, and commerce, and others more indirectly by saving certain expenses to the community, in regard to public health, &c. The scheme necessarily includes a very large number of subjects, and is generally well adapted to the end in view. Certain modifications might, however, prove beneficial. In the examinations in mechanical drawing and building construction, the success of the candidate depends too much upon his expert manipulation, cleverness in copying drawings to the same or a larger scale, and in being able to correct errors or omissions in detail, intentionally made, in the copies. All this is very good in its place, and speaks well for a candidate who is able to do it, but he should also be tested in his ability to draw simple subjects, from general dimensions and instructions. In addition to nimbleness of fingers, the candidate who takes the second or difficult paper should always have an opportunity to show evidence of a knowledge of curves of penetration, development of surfaces, and some of the more difficult problems belonging to the higher departments of the subjects. Such problems as the following, for instance, might be given:—1. To draw the curve of penetration of two pipes unequal in diameter intersecting at right angles. 2. To draw an oblique section of an elliptic tube at a given angle, having only the original diameters given. 3. To develope the surface of the arch of a skew bridge. 4. To draw the hip or angle rib of a domed roof, having only dimensions of some other parts given. 5. To draw the plan of a lobby and staircase rising 11 ft. in a space of 11 ft. by 6 in. No doubt teachers include such problems as these in their lessons given to their more advanced pupils, and it will be wise for them not to treat them with comparative neglect because they have produced few results in the late examinations. It is possible that they may occupy the most prominent place in the papers of the next or some succeeding year. Elementary mathematics, as the handmaid of geometrical, mechanical, and architectural drawing, theoretical and applied mechanics, steam navigation, and nautical astronomy, is one of the most important subjects on the list. It should be made as attractive as possible; but it is rather repulsive, both to teachers and pupils, from its extent and difficulty. It includes arithmetic, mensuration, geometry, algebra, and plane trigonometry, which form four and a half subjects in the scheme of the Society of Arts. In the Government pupil teacher scheme for elementary schools, three years are allowed for a thorough grounding in about half the mathematical matter which is here crowded together for a science teacher to wade through with his pupils in from twenty-five to forty lessons. This simply tends to produce a system of cramming, where there ought to be a solid groundwork laid, to serve as a sure foundation whereon to build a superstructure of sound knowledge from cognate sciences. The value of geometry can scarcely be overrated, both on account of the logical training its study gives to the mind, and of the important aid its problems and propositions afford in the study of the majority of scientifics. It is generally placed in the background in this examination, one or two questions only out of twelve, of which only eight can be taken, being devoted to pure geometry. Surely, if such pairs of subjects as vegetable physiology

and systematic botany, or mining and metallurgy, or navigation and nautical astronomy, or geology and mineralogy, ought not to be simplified and grouped together, there is reason to assert that the subjects now crowded under the name elementary mathematics ought not. It might be split into two parts:—1. Geometry and mensuration. 2. Algebra and plane trigonometry. Or the 6th and 11th book of Euclid, with the higher parts of algebra and trigonometry, and the theory and calculation of logarithms, might form a second course of elementary mathematics. The examination in applied mechanics has hitherto proved nearly a failure. Comparatively few students have attempted the subject, and of these too large a percentage have failed. This year we have been favoured with a new examiner and a new style of questions. The thoroughly practical nature of the last paper may be admired, but it would take many students and their teachers disagreeably by surprise. This subject, like some of those in art, should be subdivided, leaving the student the option of taking that division most suitable to his wants. There might be three divisions:—1. Mechanics applied in the construction of machinery used in carding, spinning, and weaving cotton, wool, and silk, and in millwrights' work generally. 2. Mechanics applied in the construction and use of tools, embracing screw-cutting and other lathes, planing, punching, morticing, rolling, slotting, sewing, and sawing machines, steam hammers, hydrostatic presses, and hydraulic and other cranes, and agricultural implements. 3. Mechanics applied in the construction and use of mathematical and philosophical instruments, including air pumps, hydrometers, verniers, chronometers, clocks, watches, and all sorts of weighing and measuring apparatus. A fourth division, relating to the construction and working of steam-engines, may be considered to be embraced in the examination in steam as now conducted. The course of instruction in organic and inorganic chemistry might be supplemented by one in chemistry, applied to the arts and manufactures. This might be subdivided thus: — 1. Chemistry applied in dyeing, calico printing, bleaching, tanning, and lithography. 2. Chemistry applied in glass-making and staining, pottery manufacture, enamelling, electro-metallurgy, photography, and the manufacture of paints, varnishes, and stains for wood. 3. Chemistry applied in brewing and distillation, in the manufacture of gas and other products from coal, and in those of sugar, starch, alum, soap, and other articles of commerce. 4. The application of chemistry and geology to agriculture. A few good and inexpensive handbooks are required for the use of students in such subjects as mechanical drawing, building construction, and applied mechanics. There will always arise some disappointment in the results of examinations, but science teachers still have a right to complain that this is unfairly increased by the irregularity of the papers as to their hardness. That in geometrical drawing and others might be quoted as an example this year. There are also still many students who receive a fair amount of instruction from their teachers, who, from sickness and other causes, never present themselves at all. These facts tend to show that it would be fairer to teachers, and render their remuneration more certain and uniform, if the payments to them included a capitation grant for the average attendance. The fear that the schools might be crowded with incapables will prevent the adoption of this principle. The use of a harder and easier paper in each subject may have its advantages, but the system of one paper still seems preferable. The proposition of the recent commission on technical education to introduce into day schools an examination in science similar to the first grade one in art is worthy of adoption. It should be extended to night schools, and should take place in the beginning of March. The grants made on this account may be deducted from the payments to the science teachers, but they would be repaid by a large attendance of pupils better prepared to receive their instruction. The Government exhibition scheme will not for some time produce much effect, and the want of science colleges should be attended to. The necessity of a sound and superior elementary education has been more than once pointed out to the Government authorities from the city of Manchester, but we are still under the new code, and likely to be. The effect of that code has been, as Mr. Lowe has boasted, to reduce the grants, but not, as he has dogmatically asserted, to improve the education of the children of the working classes. Its effect has simply been to cause increased attention to be paid to the lower classes, and to the duller children, owing to the adoption of a uniform standard. It has, however, lowered the standard of attainments in many of the best schools, and has ruined the first-class in the majority of cases. So far as preparation for technical education in the after lives of the pupils is concerned, its adoption has been a retrogressional step. The rescinding of the rule which took away from a teacher part of his payments if he had a pupil who passed in more subjects than one in one year, is an act of justice for which teachers will be grateful. It may be that the standard may be raised a little, but that is better than the old unjust rule. A low standard would render certificates comparatively useless. There is not much fear of that becoming a subject of complaint. It would be much more satisfactory to students if certificates were actually sent to the successful candidates. The lessons which the Paris Exhibition taught last year have done good, and have had a tendency to make people set a higher value upon technical education. They have tended to induce the artisans and master manufacturers to co-operate more with the science and art department. The discussions which have taken place on the subject have made the Government scheme better known and appreciated. Still there is much to be desired in this respect, for, as science inspectors have complained, even science committees often very imperfectly comprehend the scheme they are helping to carry out. There can be no doubt the Government scheme is progressing in extent and usefulness, although the disappointments and the uncertainty of results to which reference has been made, will have an unfavourable effect upon its development. The prospects of science schools and science teachers may fairly be considered to be improved and improving. As elementary teachers appear to be sitting for science certificates pretty extensively, we may hope that in a short time there will be no difficulty in obtaining teachers for some subjects in all small towns, and even in villages. It will be a relief from the monotony of their daily routine and secluded life to teach a science class or two in winter evenings. For many subjects there is no reason why they should not easily qualify themselves and become good teachers. For such subjects as mechanical drawing, building construction, applied mechanics, steam, and navigation, they are not generally so well adapted from lack of practical knowledge.* The magnificent example set by Mr. Whitworth will, it is to be hoped, be followed by others on a smaller scale. There is ample scope for the benevolence of the friends of the working classes to be exercised in the establishment of museums and public libraries. Many of our towns, large and small, are destitute of anything worthy of the name. An essay might be writttn on this subject, but time will not permit further reference to it here. It is, indeed, perhaps, futile to discuss it, when in some of our smaller towns it is not easy to get even the ordinary apparatus for science classes. We must not let obstacles like these discourage us, but hope for better days. As Britons we know we have pluck, energy, brains, and that wonderful engine of power, wealth. And if once aroused to do our duty we will not allow ourselves to be pointed out in the

* The rule compelling teachers to sit with their pupils if they want a certificate will never be popular with them, but it is a great convenience to some.

rear ranks of civilisation; nor will we suffer the land of the illustrious Newton to occupy a second or third rate place among the nations of the earth in regard to the scientific status of its people.

A discussion followed, in which Mr. Cope, Preston; Mr. Spriggs, Manchester; Mr. Plant, Salford; Mr. Isherwood, Blackburn; Mr. Angel, Manchester; Mr. Sutcliffe, Church; and other gentlemen took part.

Dr. JOHN WATTS said he had listened with pleasure to the paper read by Mr. Brown. He looked upon it as a very valuable contribution to the science class of literature, and he hoped it might get a wide circulation, and be considered as it deserved to be considered. He agreed with the necessity pointed out by Mr. Brown of the subdivision of the subjects upon which examinations were now held, because there was no doubt that the great mass of subjects which were crowded into a paper, and the great variety of questions in the same paper, tended to confuse the student and to prevent his passing in many cases, and if the subjects were subdivided and systematised it would be better for the pupil as well as the teacher. He had heard it stated that it was utterly impossible to take a student through a particular named subject in one year, so as to secure a first-class certificate; and he should like to ask whether it was an absolute necessity that a youth should travel through a subject in one year, and whether the proportion of the failures would not be less, and the pecuniary remuneration of the teacher more, if the subject were spread over two or three years? It seemed to him that if that course were adopted the certainty of success would be very much greater than it was now. He was sure the meeting that evening would be found, before another twelve months, to have borne fruit in the way of making the position of the science teacher more satisfactory.

Mr. TRAICE (Manchester) urged the adoption of some more efficient means for the preparation of the pupils. If that were secured he believed it would remove four-fifths of the existing difficulties, and remove them far more completely than any coercive system.

Mr. GEE (Hyde) moved a vote of thanks to Mr. Brown for his excellent paper. This was seconded by Dr. BAHIN (Rochdale), and carried unanimously.

Mr. BROWN acknowledged the vote of thanks; and a similar compliment to Dr. Pankhurst for presiding closed the proceedings.

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YORKSHIRE BOARD OF EDUCATION.—The scarcity of teachers in Yorkshire duly qualified to give instruction in science in accordance with the regulations of the Department of Science and Art, has led the Council of the Yorkshire Board of Education to concert measures for the supply of the deficiency. One important step is the organisation of schoolmasters' science classes to meet on the afternoons of Saturday during the winter, for the study of special branches of science. The movement was brought under the notice of the schoolmasters in the Leeds district, at a public meeting held on Saturday, in the Civil Court of the Town-hall, under the presidency of Sir Andrew Fairbairn, mayor of Leeds, who was supported by Mr. J. F. Iselin, M.A., Government Inspector for Science; Rev. A. Pickard, M.A., and Mr. J. G. Fitch, M.A., Her Majesty's Inspectors of Schools; Mr. E. Huth, Chairman of the Yorkshire Union of Mechanics' Institutes; Mr. W. H. J. Traice, Member of the Council of the Lancashire and Cheshire Union of Institutes; Rev. W. G. Henderson, D.C.L., Head Master of the Leeds Grammar School; Mr. S. Sharpe, LL.B., Head Master of Huddersfield College; Dr. Haigh, of Bramham College; Mr. L. W. Scudamore, B.A.; Mr. T. Hick, B.A.; Mr. G. Jarmain; Mr. E. Ison; Mr. Henry H. Sales, Hon. Sec. of the Yorkshire Board of Education; and other influential gentlemen connected with education. The first class will be opened in Leeds on Saturday, October 3rd, and the course will consist of twenty-eight lessons in inorganic and organic chemistry, by Mr. G. Jarman, head-master of the Science Schools at Halifax and Huddersfield, and will include all the subjects contained in syllabus of the Department of Science and Art, Subjects X. and XI. Each lesson will be about two hours in length. Classes of a like character will be formed forthwith in Sheffield and Stockton-on-Tees. By providing a staff of men qualified to conduct evening science classes for adults, the Council of the Yorkshire Board hope to be able to bring instruction in science within the reach and means of the industrial population of the county.

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## EXAMINATION PAPERS, 1868.

*(Continued from page 736.)*

The following are the Examination Papers set in the various subjects at the Final Examination held in April last:—

### POLITICAL AND SOCIAL ECONOMY.

THREE HOURS ALLOWED.

1. How are guardians appointed, and what are their rights and duties?
2. What are the rights of a husband to the property of his wife, with a distinction between that which is personal and that which is real?
3. What is the law as to apprentices, and what changes have at different tmes been made in it.
4. What was the conflict between the law of England and that of the civilians and canonists as to the legitimacy of *antenati?*
5. Describe the "Act of Settlement."
6. What are the privileges of Parliament, and what is their foundation?
7. What is the English law of naturalisation, and what inconveniences have arisen or may arise from it?
8. What are letters of marque and reprisals, and under what circumstances may they be granted?

*Questions from Professor Fawcett's Manual for those who aspire to a first-class certificate.*

1. Of what elements does profit consist, and on what does the rate of profit depend?
2. What are the restrictions put by trades' unions on the employment of apprentices? What can be said against such restrictions, and what if any thing for them?
3. Describe the different forms of co-operation; the merits and defects of each.
4. In what way do you divide commodities in reference to the circumstances that determine their price?
5. Describe the different forms and the different purposes of credit. In what case is credit beneficial, and in what is it otherwise?
6. What do you understand by equality of taxation, and how is it best secured?

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### GEOGRAPHY.

THREE HOURS ALLOWED.

1. Write a brief description of the physical features of either England, Scotland, or Ireland, with reference especially to the distribution of the high grounds and the direction of the river-basins.
2. Specify the principal seats of manufacturing industry in England and Scotland, naming the more considerable towns within each, and the description of manufacture carried on.
3. What conditions of outline, climate, and physical geography in general, distinguish Europe from other parts of the globe?
4. Draw (from memory) an outline map of either France, Spain, Italy, or Russia. Show on it the direction of the high grounds, the courses of the principal rivers, and a few of the larger towns.
5. Give some account of the natural features of Germany, as a whole—its mountains, river-basins, &c.—without reference to its political divisions.
6. What are the main conditions in the present political

division of Germany? What changes in this respect were consequent on the war of 1866? What number of German States are there at the present time, and which is most powerful amongst them?

7. In which of the German States are situated, respectively, Magdeburg, Breslau, Gottingen, Leipzig, Nuremberg, Carlsruhe, Heidelberg, Weimar, Darmstadt, Rostock, Kiel, and Frankfort-on-the-Main? Describe briefly the locality of each.

8. Name twelve of the largest cities of the United States; specify which amongst them are on the Atlantic seaboard, which within the valley of the Mississippi, which beyond the Rocky Mountains.

9. Describe briefly the physical features of the Australian continent as a whole. What colonies does it now include?

10. Draw (from memory) a map of one of the Australian colonies, or of New Zealand.

11. Give some account of the currents of the Atlantic Ocean, and particularly of the Gulf stream. How are the currents accounted for?

12. To what regions are the following respectively indigenous:—coffee, cocoa, sugar-cane, clove and nutmeg, cassava (mandioca), tobacco, potatoe, maize, yam, bread-fruit, date-palm, cocoa-nut palm? Give some instances of the changes effected by human agency in the distribution of these or other productions of the Old and New Worlds respectively.

### ENGLISH HISTORY.

THREE HOURS ALLOWED.

General Questions.

1. Give an account of the social condition of the Britons at the time when this island fell under the notice of Cæsar; and show what improvements were introduced at its conquest by the Romans.

2. How long did the Roman occupation last? State briefly some of the main events which happened during that interval.

3. Write a brief account of the life of Alfred, with the dates; and state what laws and institutions have been attributed to this king.

4. What were the judicial methods in use among the Anglo-Saxons for detecting and punishing civil offences?

5. Give the dates of the Norman Conquest, and the succession of the different Norman kings. Show their relations to each other.

6. What was the subject of dispute between the Norman kings and the Archbishops of Canterbury, and between Henry II. and the Archbishop Thomas à Becket?

7. Give the dates of the following events:—The accession of John—Magna Charta—The Barons' wars—The battle of Lewes—Meeting of the first House of Commons—Conquest of Ireland—Reduction of Wales—Battle of Bannockburn.

8. When did the Plantagenet dynasty commence? When did it close? Mention the names and give the dates of the accession of the most eminent kings of this line.

9. What constitutional advantages were gained under the Plantagenet and Lancastrian kings?

10. How were the claims of the contending factions reconciled by the accession of Henry VII.?

11. Give the dates of the accession of Henry VIII.—The separation of this country from Rome—The death of Cardinal Wolsey—The accession of Edward VI.—Of Elizabeth—The Spanish Armada—The establishment of the Court of High Commission.

12. What was the purpose of the Hampton Court Conference?

13. By what ministers were the counsels of Charles I. successively directed? What were the distinct aims of each, and what the final result?

14. Place these names under the reigns to which they belong:—Lord Bacon, Locke, Burke, Dryden, Spenser, Robert Earl of Essex, the two Pitts, Sir Isaac Newton' Sir Humphrey Davy.

Special.

(a.) When did the Long Parliament commence and end? How many parliaments were summoned by Charles II.? What were the chief questions in debate between the king and the House of Commons?

(b.) What circumstances tended to foment that jealousy of the Roman Catholics which broke out in the reign of Charles II.? In what actions did that jealousy display itself?

(c.) Give an account of any one of the following statesmen:—The first Earl of Shaftesbury; Edward Hyde, Lord Clarendon; Lord William Russell.

*(To be continued.)*

## THE SANCHI TOPE IN CENTRAL INDIA.

The members of the Society will be glad to see the first-fruits of the discussion which followed Mr. Fergusson's lecture on Indian Architecture. This tope is one of the most ancient and remarkable Buddhist architectural remains in India, dating 250 B.C.; and recently an application was made to the Begum of Bhopal, in whose territories it is, by the French Consul-General, M. Place, to allow the principal gateway of the tope to be carried off and set up in Paris!—a cool satire on the apathy with which the Indian Government has hitherto viewed the curious, very ancient, and comparatively unknown architecture of India. But the Begum, who, being a Mahommedan, is indifferent to Buddhist buildings, before consenting to M. Place's proposal, offered the gateway to the Indian Government, to be sent to England. The Indian Government, with highly proper feeling, declined the gift, and recommended that the tope should be properly conserved, and suggested that it would be quite sufficient for France and England to have casts of the gateway, which is of a highly decorative character. In former years, the gateway would probably have found its way to the Place de la Concorde, in Paris. Now, the interest of the Indian Government is awakened, and has begun measures for conserving both this and the numerous other monuments in India, of which the fruits by means of photographs and casts are likely to appear in this country, due allowance being made for the slowness of Indian movements.

## Fine Arts.

Palace of the Fine Arts—Vienna.—The ceremony of laying the first stone of the Palais des Beaux Arts, in the capital of Austria, took place on the first day of the present month; the Emperor performed the arch-mason's office, and was attendeed by the Archdukes Charles Louis and William, the Prince Hohenlohe, and all the ministers and high officers of state. Immediately that the stone was sealed, the Society of Orphéonistes sang Mendelssohn's "Chanson des Artistes." The moment chosen for the ceremony was interesting and appropriate, being that of the opening of the general exhibition of German art, which had attracted an immense number of artists to Vienna. The authorities of the city gave a banquet in honour of this the tenth meeting of the artists of Germany, the number of guests amounting to 550, the bourgomaster of Vienna filling the presidential chair, and being supported by the ministers Giskra, Hasner, Taaffe, Herbst, Kuhn, Berger, and many other notabilities. M. Hasner, in proposing a toast, said, German art had never ceased to flourish, during adversity as in prosperity, and the artists of Germany had never ceased to be united; there was but one German school, and he asked the guests to drink to the honour of German art without

distinction or limitation. A grand entertainment was also given to the artists at the Theatre of Vienna.

AUTHENTICATION OF A FAMOUS PICTURE.—The fine picture of the "Last Judgment," in the church of St. Marie, at Dantzic, which was for many years considered to be the work of Van Eyck, was recently pronounced, by a number of eminent judges of art, to be the production of Memling; this opinion turns out to be incorrect; the picture was, in fact, painted by the Flemish artist Stourbout, as proved by the discovery of the contract by which that painter undertook to execute the work in question for a Milanese nobleman.

COMPLETION OF THE RESTORATION OF A CATHEDRAL.—A grand ceremony took place the other day at Auteen, to inaugurate the Cathedral of Saint Lazare, in that town, the restoration of which has just been completed, after thirty years' labour, under the direction of M. Viollet-Leduc and M. Durand.

## Manufactures.

EXTRACTION OF SULPHUR FROM THE ORE. — The *Amico del Popolo* of Palermo gives an account of some experiments that were made in the neighbourhood of that city on the 5th of August and following day, for extracting sulphur from the ore, by means of steam at a high temperature. This apparatus belonged to the Sociàtà Privilégiata per li Zolfi, in Italia, and was fully described in the Society's *Journal*, page 445, and the experiments seem to have been most successful, the sulphur being obtained in about two hours from the introduction of the ore into the apparatus. These experiments were attended by the principal proprietors of sulphur-mines in Sicily, and by others engaged in this industry, and seems to have given great satisfaction to all present.

SILVERING GLASS.—A French chemist, named Dodé, has been engaged for many years in perfecting a new method of preparing looking-glass, and is said to have succeeded. In place of mercury he uses platinum, but so finely divided, that his method is only half as costly as the ordinary one. The platinum is dissolved in nitro-muriatic acid, the excess of the latter being got rid of by evaporation, and the metal left in the state of chloride, and to this is added a certain quantity, not stated, of essential oil of lavender; the platinum immediately abandons the aqueous solution for the essence, which holds it in suspension. Small quantities of litharge and borate of lead are then added, and this mixture is laid on the glass by means of a brush. Finally, the glass is placed in an annealing furnace, which is heated to redness, the litharge and borate of lead are melted, and the platinum adheres firmly to the surface of the glass. In the notice concerning this new process in the *Moniteur Scientific* of Paris, it is stated, that for the application of the new method any kind of glass may be used, even bottle-glass, for the platinum causes all faults to disappear, and, which sounds more extraordinary still, that glass thus prepared is transparent, and may therefore be used for windows. It is difficult to imagine a glass at once transparent and reflecting.

THE MINERAL PRODUCTIONS OF THE ZOLLVEREIN.—In 1866 there were 198 gold and silver mines in the Zollverein, employing 10,212 workmen, and producing 641,001 cwt. of gold and silver ore. The greater part of these mines (viz., 176) are in Saxony, and produced 598,546 cwt. of ore, which may be valued at 1,267,052 dollars. The Prussian mines produced 30,090 cwt. of ore; those of Bavaria 2,850 cwt.; and those of Hainault 17,515 cwt. The total value of the metals obtained from all the German mines (with the exception of those of Hainault), in 1866, amounted to 1,301,431 dollars. The average yearly production from 1861 to 1865 was about 679,039 cwt. In 1867 the gold mines only furnished 310,132 lbs. of ore, valued at 141,791 dollars; of this quantity the mines of Prussia and Brunswick furnished 9,630 lbs., and those of Saxony 234,502 lbs. The production of silver was more important. In 13 smelting works, employing 2,000 workmen, 157,084 lbs. of silver were obtained.

## Commerce.

RAILWAYS IN AMERICA.—The American journals give the following statistics of the railways in the United States in 1867:—

| | LENGTH. | OPENED. |
|---|---|---|
| | Miles. | Miles. |
| Maine | 638 | 512 |
| New Hampshire | 667 | 667 |
| Vermont | 661 | 588 |
| Massachusetts | 1,479 | 1,400 |
| Rhode Island | 151 | 119 |
| Connecticut | 793 | 637 |
| New York | 3,820 | 3,182 |
| New Jersey | 964 | 911 |
| Pennsylvania | 4,682 | 4,192 |
| Delaware | 177 | 160 |
| Maryland | 855 | 606 |
| West Virginia | 586 | 364 |
| Virginia | 1,973 | 1,494 |
| North Carolina | 1,367 | 1,000 |
| South Carolina | 1,109 | 1,007 |
| Georgia | 1,750 | 1,547 |
| Florida | 606 | 439 |
| Alabama | 1,577 | 850 |
| Mississippi | 897 | 897 |
| Louisiana | 872 | 333 |
| Tennessee | 1,508 | 1,326 |
| Kentucky | 1,012 | 634 |
| Arkansas | 1,921 | 113 |
| Texas | 2,590 | 495 |
| Ohio | 3,726 | 3,387 |
| Indiana | 2,606 | 2,306 |
| Illinois | 3,607 | 3,224 |
| Michigan | 1,851 | 1,063 |
| Wisconsin | 1,467 | 1,036 |
| Minnesota | 1,646 | 419 |
| Iowa | 2,146 | 1,209 |
| Nebraska | 988 | 555 |
| Missouri | 1,494 | 984 |
| Kansas | 835 | 494 |
| California | 1,098 | 392 |
| Nevada and Utah | 545 | 30 |
| Oregon | 259 | 19 |
| Total | 54,325 | 38,605 |
| Total in 1866 | 51,606 | 36,896 |
| Increase in 1867 | 2,719 | 1,709 |

EXPORT OF OIL FROM GALLIPOLI.—The exports of oil during the first half of each year, for the last five years, is as follows:—

| | Exported. | In store at Gallipoli. |
|---|---|---|
| | Salmas. | Salmas. |
| 1864 | 30,760 | 12,000 |
| 1865 | 27,950 | 39,500 |
| 1866 | 41,449 | 11,800 |
| 1867 | 9,000 | 10,500 |
| 1868 | 18,352 | 8,500 |

COMMERCE OF ALBANIA.—The *Osservatore Triestino* gives the following statistics of the commerce and movement of shipping in the ports of Upper and Central Albania during 1867. The imports at the ports of

Antinari, Scutari, Durazzo, and Vallona amounted in value to 11,142,650 frs., and the exports to 6,367,627 frs. The imports were divided as follows:—Austria, 6,876,405 frs.; Italy, 1,635,547 frs.; Greece, 1,251,727 frs.; Turkey, 1,378,971 frs. The exports were:—Austria, 3,654,399 frs.; Italy, 1,502,853 frs.; Greece, 698,218 frs.; Turkey, 512,152 frs. Manufactured goods figure for about half the amount of the imports, and colonial products for a quarter. The first consist principally in cloths, linens, cottons, fez, and stuff of every kind. The cloths are principally imported from Venice, and the other stuffs from Trieste. Austria and Greece furnish the colonial articles; Italy a great quantity of paper, hardware, glass, rice, and pastes; Tunis, articles of silk and iron; Marseilles, varnished leathers, looking-glasses, and fowling-pieces. Cereals form nearly one-half of the export trade, and are shipped principally from the ports of Durazzo and Vallona. The next in importance are skins, oil, salt, wax, silk, and flax. With the exception of a small quantity which is shipped to Greece, nearly the whole of the Albanian wool is exported to Trieste and Venice. The greater part of the cereals are exported to Austria, and a small quantity is exported to the southern provinces of Italy on the Adriatic. The movement of shipping during 1867 was as follows:—

*Steam-ships.*

| | | Tonnage. |
|---|---|---|
| Arrivals | 452 | 77,399 |
| Departures | 450 | 70,329 |

Of these, 444 belonged to the Austrian Lloyds, and 4 to an Albanese Company. The departures of sailing vessels amounted to 1,112, of a total tonnage of 30,349; of these, 94, of 3,241 tons, sailed for Austria; 84, of 2,966 tons, for Italy; 398, of 2,579 tons, for Greece; and 540, of 14,558 tons, for Turkey. The arrivals from Austrian ports were 95 vessels, of 3,308 tons; 82, of 2,898 tons, from Italian ports; 397, of 9,481 tons, from Greece; and 528, of 14,706 tons, from Turkey.

THE VINTAGE IN FRANCE.—The production of wine in France, according to the *Constitutionnel*, was 68 millions of hectolitres (1,496,657,356 gallons) in 1865; in 1867 it was 65 millions of hectolitres (1,430,628,355 gallons); and this year the vintage is estimated to be 72 millions of hectolitres (1,584,696,024 gallons).

## Colonies.

HARBOURS AND RIVERS.—The residents of Paramatta are agitating for the stationing of a steam dredge in the river Paramatta, to deepen the course of navigation; and their claim is based principally upon the advantage it would confer upon the residents on the north bank of the river, who are producers of fruit to a large extent, and which could be conveyed to market easily by the natural highway. The plant recently employed in the improvement of the Wollongong Harbour has been removed to Kiama, and the work of dredging will be immediately commenced there. The snagging operations on the Murray are being energetically carried out. There are now on that river two steam-winch parties and two hand-winches, under the pay of the New South Wales Government, besides the Victorian party. As the result of one season's work of the New South Wales party, it may be stated, that by the time the navigation opens, about seventy miles of water, from Wahgunyah to Albury, will have been rendered navigable with ordinary care on the part of the steamboats' crews. It is the general opinion that the snagging system now used on the Murray is one that is sufficiently good for all practical and economic purposes.

NEW ZEALAND.—The whale fishery is commenced, and if the season continues as well as it has commenced it will be a very successful one. Numbers of whales were seen in the Straits during rough weather, but it was much too dangerous to attempt to follow them.

REVENUE.—The quarterly return of the revenue for South Australia show the receipts have been £170,360, being a falling off of £10,000 on the corresponding quarter last year. The expenditure was £183,000.

LABOUR IN NEW SOUTH WALES.—The colony is just now undergoing depletion of a very injurious kind, its most useful workmen deserting it by hundreds and thousands. A new gold field has been discovered in Queensland, and as it is about 1,200 miles distant, and very little is yet known in regard to it, it has attractions for Victorian miners which they seem unable to resist. Accordingly, they are throwing up their work, and hurrying away to take their luck at the new diggings. The men are not leaving the colony because they are badly off, but because they have available money for the gratification of the impulse which has seized upon them, and something to support their wives and families in their absence. The emigrating miners will start with from £10 to £25 in their pockets, and leave as much behind, a sum which falls to the share of few labouring men in Great Britain. It is worthy of remark also, that these men are running away from £2 5s. a-week for eight hours' work a day, and excellent meat at 2d. a pound.

WESTERN AUSTRALIA.—Since the commencement of the administration of the present governor, in 1862, the revenue has increased from £60,425 to £77,652 in 1867; our exports from £10,708 to £157,886; our imports from £162,296 to £216,290; and the population from 17,000 to 21,719. During the period under review we have emerged from the condition of a breadstuff importing community to that of an exporter of that article, owing to the very judicious land regulations formed under Governor Kenneday's auspices, by which our agricultural lands were placed within the means of occupation of the working classes; and the price of grain has fortunately never fallen below what would remunerate the grower. During the same period also the value of wool has been unprecedentedly high; and although our stock owners met with a serious drawback in the spring, in the shape of drought, they have, on the whole, prospered greatly.

SUGAR.—The progress of sugar-growing has occupied a considerable degree of attention in the colony of New South Wales since last mail, and considerable impetus will no doubt be given to that branch of industry by the proposal of a local refining company, if sufficient inducement offer by the growth of cane, to erect mills in the central sugar-growing districts for the convenience of the planters. There is also a movement going forward for the erection of mills under partnerships, working under the law of limited liability. In the Hastings district sugar of colonial growth is coming into domestic use; and Mr. Meeres, who has sold a quantity, grown and manufactured on his plantation, at full rates, is about sending his molasses to England. It is believed that there were, in 1867, about 280 acres of ground at the Hastings River under cane crop, 250 acres on the Lower and Upper Manning. As evidence of the adaptability of soil and climate, it may be mentioned that one grower, who has been endeavouring to induce the farmers of the colony to plant cane since 1825, reports that upon good land, duly treated, from eight to twelve crops can be obtained from one planting.

## Notes.

WHEAT CULTIVATION.—Mr. Read, the member for Norfolk, in a paper lately read before the British Association, says:—"There can be no doubt that the yield of wheat in Norfolk has greatly increased during the past twenty-five years. From only one part of the country have my correspondents intimated that there is but little change. This comes from some of the best land in Norfolk, where great crops of wheat were common full fifty years ago. The repetition of wheat on

these soils may be more frequent, but the yield does not seem to have perceptibly increased. And until we discover some chemical manure—some soluble silica for instance—that will strengthen the straw in moist seasons and enable it to bear a large and fuller ear, any increase of yield in these fertile districts must remain in abeyance, for already the greatest loss is incurred from the crop lodging at an early period of its growth, and the more the crop is forced the more this tendency of the straw to go down increases. Thin and early sowing, with a thorough consolidation of the land, may in a measure alleviate this increasing difficulty, but once let the chemist show us how to stiffen the straw of our cereals, and then the produce, for aught we know, may be doubled unless they should be smitten with blight and mildew—diseases which so frequently attack over-stimulated crops. On the thin chalks and light lands of Norfolk, the yield and extent of wheat is increased. Twenty-five years ago it was considered that twenty-six to twenty-eight bushels per acre was the full average yield of wheat for the county. In 1854 Sir J. Walsham estimated it at thirty bushels, and I think we may now put it at thirty-two bushels or four quarters per acre, but this is fully four bushels an acre over the average of the last four years—including, of course, the present harvest. The extraordinary difference of the yield of wheat on moderately light land farms, in dry or moist seasons, has been furnished me by more than one large occupier. I will not give the details, but simply state that the produce has occasionally nearly reached forty-eight bushels per acre, and has frequently been less than twenty, and one year barely reached twelve, while the money return has been in a good season fifteen guineas per acre, and in a very bad one little over £3."

CHINESE LIBRARY AT ST. PETERSBURG.—The *St. Petersburg Gazette* says that there is now in the Russian capital the richest Chinese library in the world, It consists of 11,607 volumes; 1,168 wood engravings, and 276 manuscripts. The books are on all sorts of subjects, and amongst them there are several rare works. One or two of them are unique, there being no other copies, even in the largest libraries in China. The library was collected by M. Skatchoff, now Consul-General in Pekin, during a residence of fifteen years in the Chinese empire. Recently M. Skatchoff offered to sell it for 9,000 roubles (3s. 1½d. each) to the Imperial Library of St. Petersburg, and the Russian Academy of Sciences, but both institutions were compelled to decline the offer for want of funds.

AGRICULTURAL EXHIBITION AT CATANIA.—The first agricultural exhibition, now open at Catania, extends from the 8th to the 19th of September, 1868. This exhibition consists of the agricultural produce, implements, and animals of the Sicilian provinces.

THE MONT CENIS TUNNEL.—During the first fortnight of the present month (August) the progress made at the Mont Cenis tunnel was 34·95 metres, of which 13·70 was driven on the Italian side at Bardonnèche, and 21·25 at Modane on the French. The position up to the 15th August was as follows:—

| | Metres. |
|---|---|
| Length driven at Bardonnèche .... | 5,132·70 |
| " " Modane ........ | 3,549·27 |
| Total length of tunnel driven ...... | 8,681·95 |
| Length remaining to be driven .... | 3,538·05 |
| Total length of tunnel .. | 12,220·00 |

## Correspondence.

SIR,—Will you allow me to suggest, through the medium of your *Journal*, that Government might, at a small expense, greatly assist in the diffusion of information upon many important public questions and subjects, if they would forward to mechanics' institutions, through the Society of Arts, copies of some of the more interesting Blue-books that are published. At present Blue-books are practically inaccessible to the large majority of people; and as they contain most valuable and authentic information, this is to be greatly regretted. I would also suggest that the British Association for the Advancement of Science, the Social Science Congress, and other learned and scientific societies, should forward to mechanics' institutions, through the Society of Arts, copies of their printed "reports" and "transactions." Doing this would be, in some degree, carrying out the objects for which these societies are established, viz., the promotion and promulgation of knowledge.—I am, &c., DUNCAN A. SHAW, Hon. Sec. to Slough Mechanics' Institution.

Slough, 7th September, 1868.

## Patents.

*From Commissioners of Patents' Journal, September* 11.

GRANTS OF PROVISIONAL PROTECTION.

Animal and vegetable substances, preserving—1475—W. Estor and M. Terrero.
Bedstead and travelling trunk combined—2721—A. M. Clark.
Bedsteads, metallic—2661—E. Peyton.
Boots, waterproof—2701—T. Toms.
Bottle corks—1517—G. F. Griffin.
Bottles, cases for packing—2695—L. F. A. P. Riviere.
Breakwaters—2671—R. Saunders.
Candlesticks—2559—W. J. Hinde.
Coal, &c., agglomerating—2677—W. E. Gedge.
Cotton, &c., preparing—2679—E. Jackson and J. Ogden.
File-planing machines—2413—H. Moritz and J. Reinach.
Fire-arms, breech-loading—2657—J. Hanson.
Fountains—2553—H. Reissmann.
Furnaces—2659—T. Wrigley.
Glass furnaces—2705—W. W. Macvay.
Hinges, swing-door—2685—S. Newton.
Ice, packing and storing—2719—A. C. Kirk.
India-rubber, &c., manufacturing porous or spongy substances from—2715—T. Forster and J. Heartfield.
Iron and steel tubes, finishing and welding—2713—J. Evans.
Looms—2173—W. Hadfield.
Looms—2653—W. Houghton.
Pianofortes—2703—E. Jobson.
Printing machines, lithographic, &c.—2673—C. H. Gardner.
Sewage, apparatus for dealing with—2667—W. Strang.
Sewing machines—2669—T. Henderson.
Ships' propellers—2275—R. Smyth.
Smoke-consuming apparatus—2663—D. Smith.
Steam engines—2687—T. Lester and W. Trueman.
Steam engines, working—2681—E. L. Paraire.
Stone, &c., cutting, &c.—2603—J. Elliott.
Telegraph wires, insulators for—2707—J. H. Greener.
Telegraphs—2665—N. J. Holmes.
Telegraphs—2683—C. F. Varley.
Turbines, apparatus for warding off leaves and other matters likely to clog the working of—2693—W. E. Gedge.
Windows, &c., rendering air and water tight—2655—E. Zoepfel.
Wire rigging, relieving coupling for—2691—W. R. Lake.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

Alimentary substances, regenerating certain—2706—H. A. Bonneville.
Fire-arms, breech-loading—2712—J. F. C. Carle.
Stones, &c., artificial—2759—C. Holland.

PATENTS SEALED.

| | |
|---|---|
| 843. F. A. Paget. | 901. W. E. Gedge. |
| 847. H. Fletcher. | 907. J. and J. Thompson. |
| 857. J. H. Maw. | 919. G. Martin. |
| 861. M. Rowand. | 927. S. Weukheim. |
| 863. C. S. Müller. | 981. W. R. Lake. |
| 873. J. P. Knight. | 1029. W. Oram. |
| 875. F. Mulliner. | 1355. J. Bernard. |
| 879. P. F. Gubault. | 1959. D. Elder. |
| 889. F. H. and C. A. Elliott. | 2091. G. Bower. |

*From Commissioners of Patents' Journal, September* 15.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

| | |
|---|---|
| 2071. M. H. Blanchard. | 2342. J. Dodd. |
| 2310. J. Brigham & R. Bickerton. | 2350. T. and T. L. G. Bell. |
| 2371. J. H. Johnson. | 3136. T. L. Nicklin. |

PATENT ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

2365. W. Stableford.